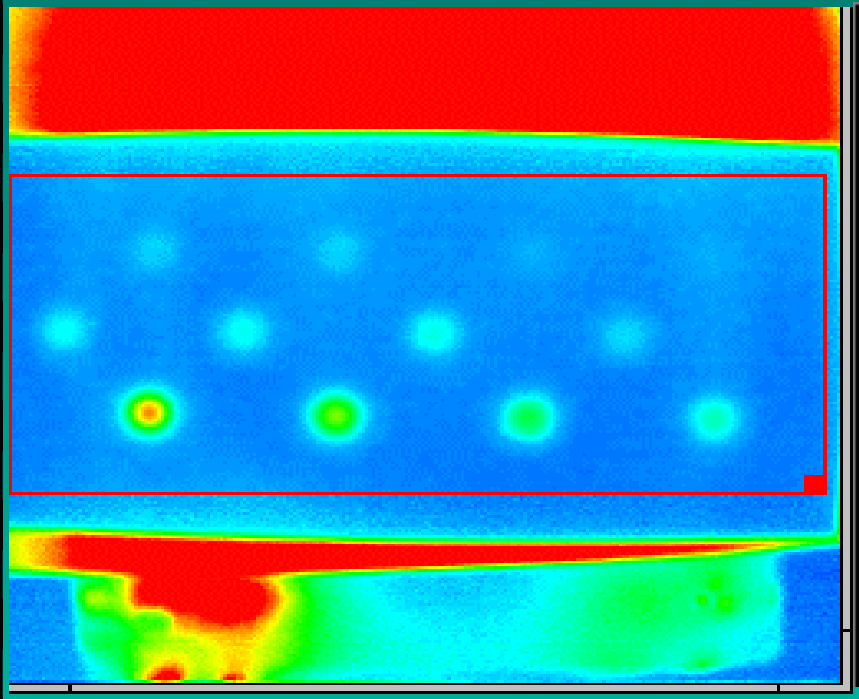
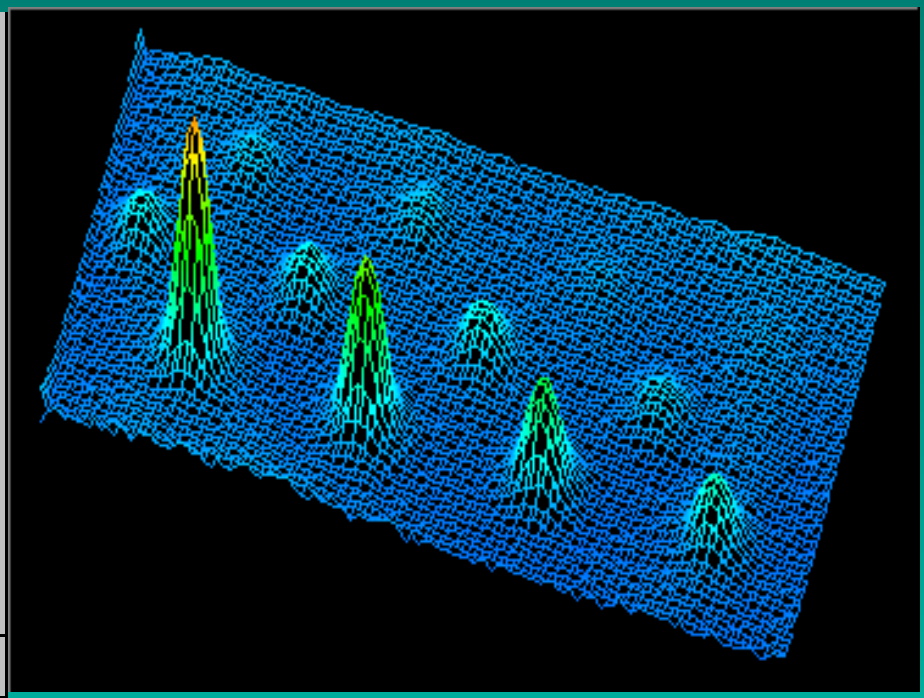
ECHOTHERM FOR PM and RESEARCH

Non-Destructive/Non-Contact Measurement

3-D Sub-Surface Depth Information of Large Areas

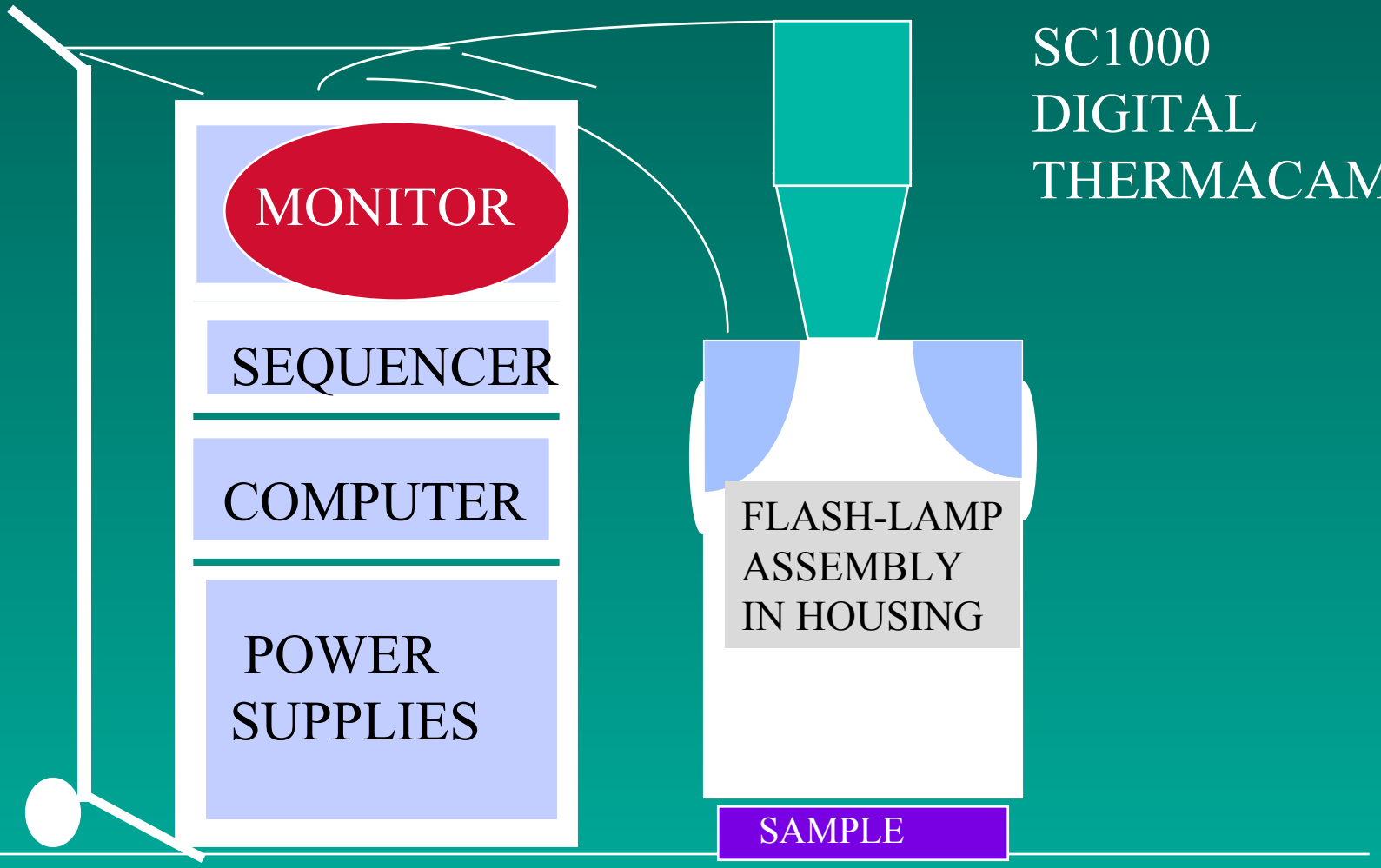
(Looking down on plate with holes on underside, 16 " X 12")





Flir

ECHOTHERM
WITH COMPUTER AND THERMACAM CAMERA

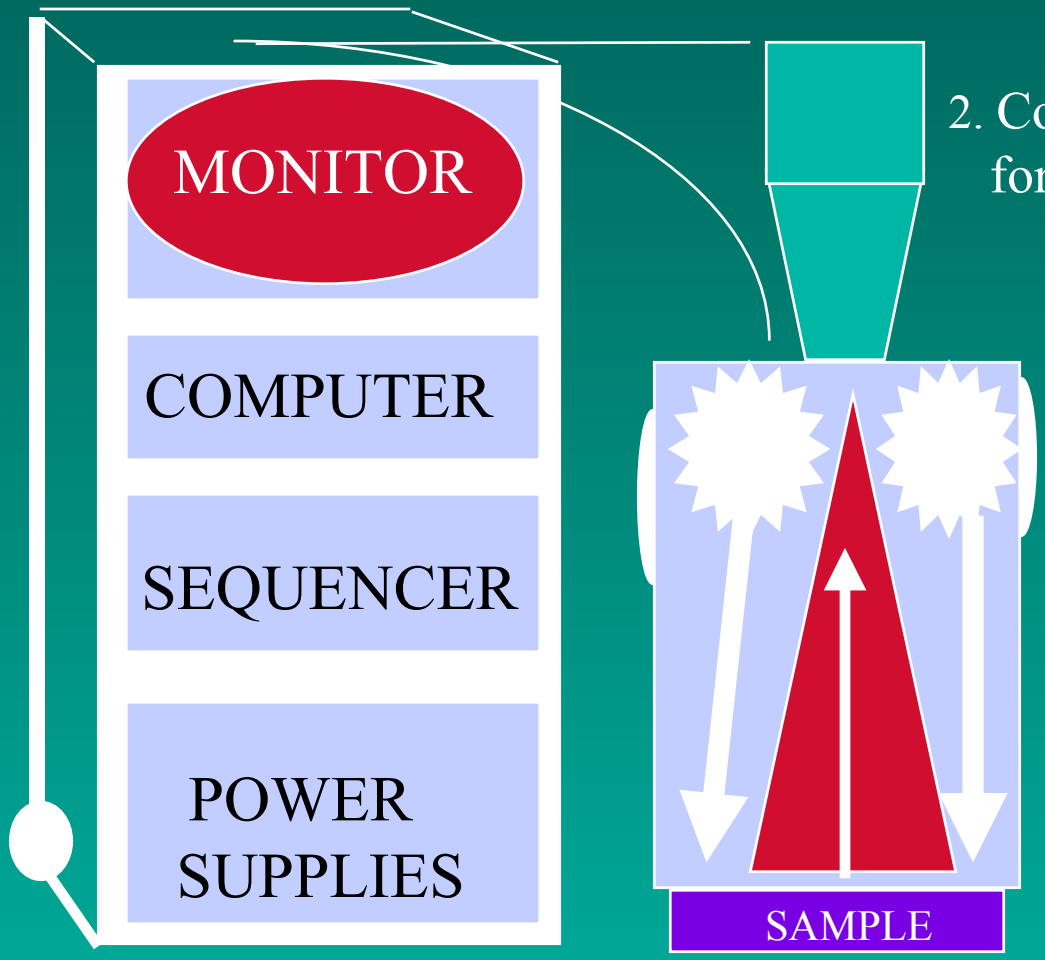


SC1000
DIGITAL
THERMACAM

Flir

ECHOTHERM IN ACTION: 6 Second Data Collection

3. Examine series of timed images with computer



2. Collect images continuously for 6 seconds, send to computer.

1. Flash sample to send out light pulse.

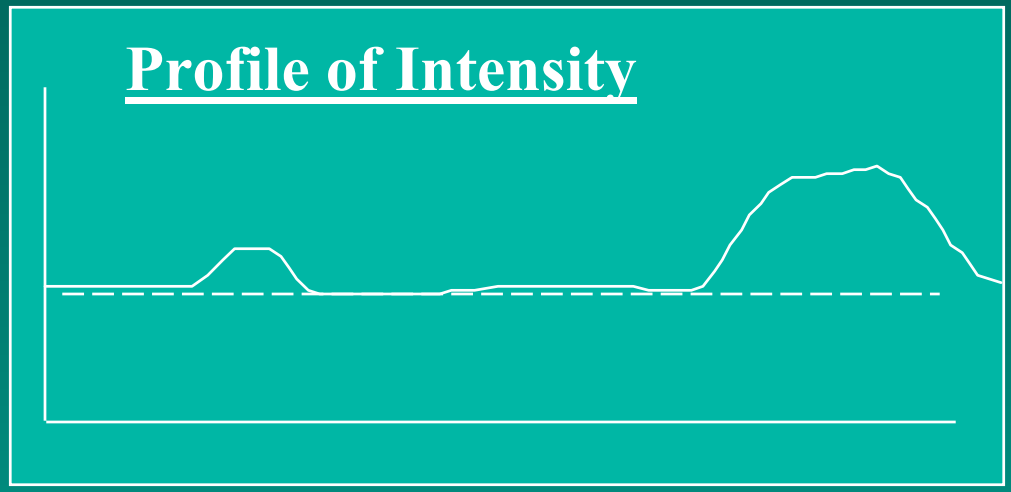
Flir

ECHOTHERM BASIC THEORY...

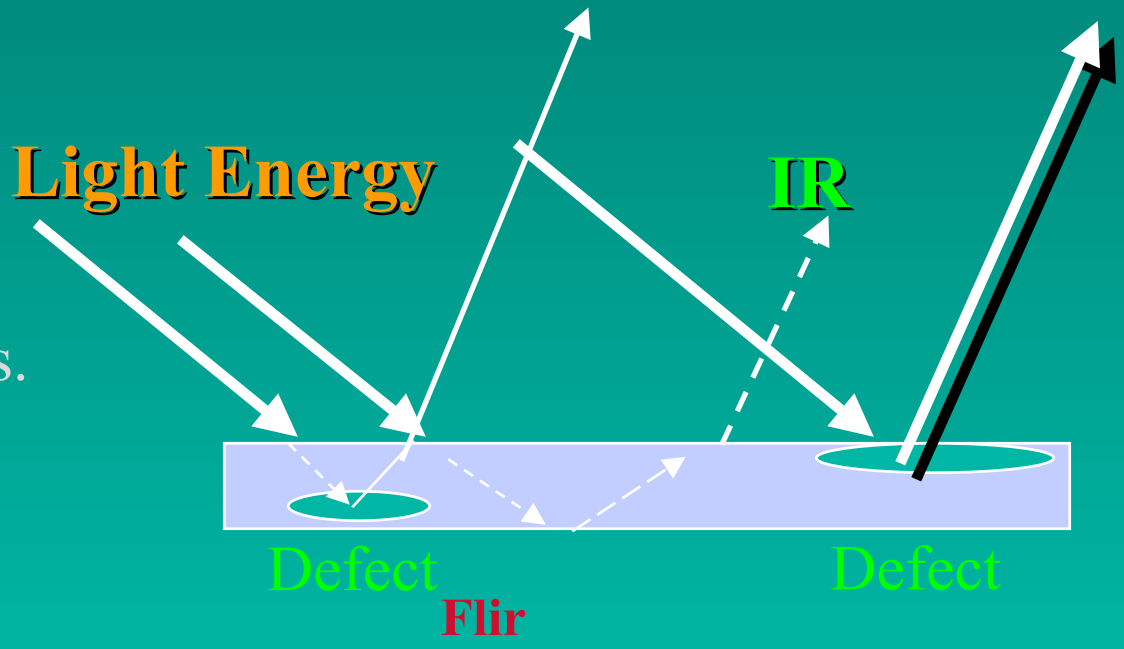
Flir

IR THERMAL WAVE IMAGING THEORY

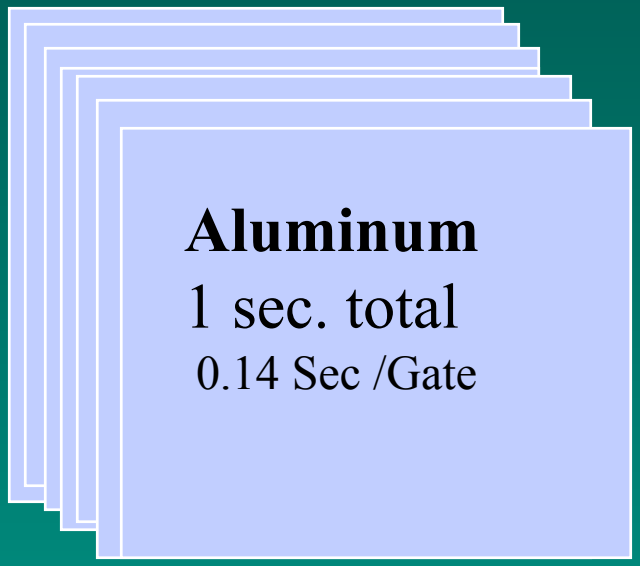
Light is transferred to thermal energy which conducts at various rates through the material. IR radiates from the surface up to camera, indicating surface defects below.

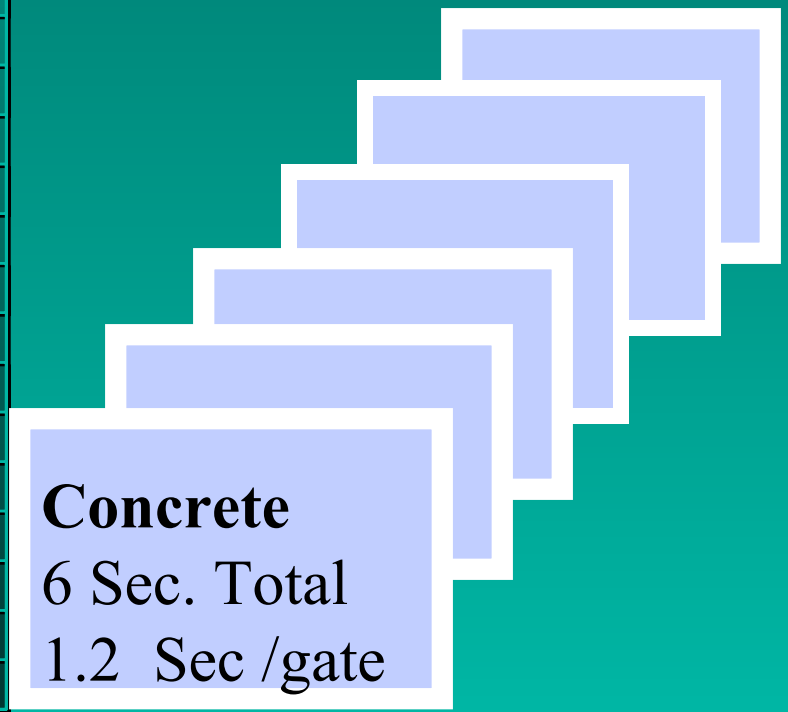


Echotherm, measures emitted IR from the surface based on time in sub-second intervals.



THE DIGITAL DATA CUBE





Images are stored like transparency pages. You can easily choose which page or gate to look at. Each gate corresponds to a 2-D picture at a specific depth. Or you can stack them and look at the whole 3-D area.

Gates are 2-D pictures of the thermal energy emitted from the surface specific points in time as the flash echoes back to the surface.

Example: Faster cooling samples such as aluminum, require short sampling gates close together over a short period of time to catch the layer with the defect.

Very dense, slow cooling samples such as concrete, may require you to collect images only every few seconds for a total period of 6 seconds.

Flir

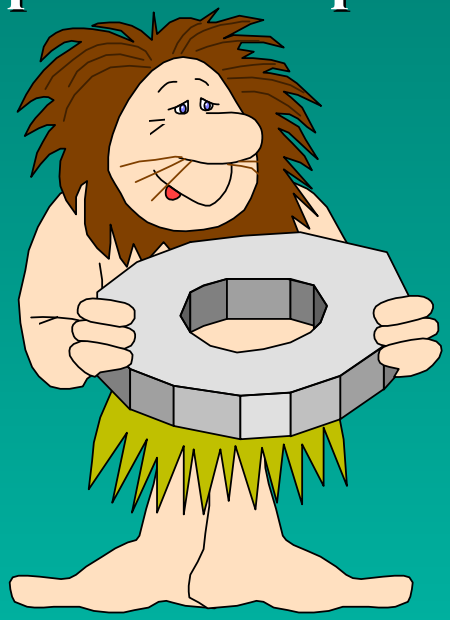
GET INFORMATION NOT AVAILABLE THROUGH ANY OTHER SINGLE METHOD!

*Large area, up to 12” X 10” and larger for some samples.

*One side access. Non-contact method works over many curves and corners. No damage to delicate surfaces.

*2-D images pinpoint defects while 3-D graphics tell depth.

*Suitable for ON-LINE processing.
No need to disturb or excite sample.
May be able to use heat generated during operation to get data instead of having to cool parts to prepare surfaces first. Good for stress testing.



Flir

AND NOW...

AN APPLICATION :

Flir

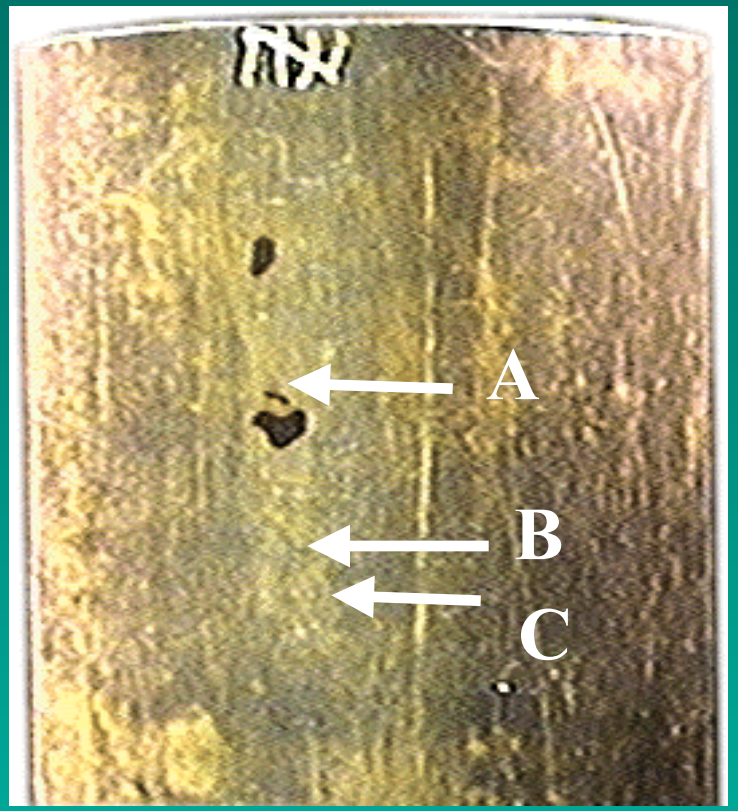
Problem:

How to accurately predict the level of corrosion on the *inside* of a pipe, from the *outside*?

Solution:

Echotherm

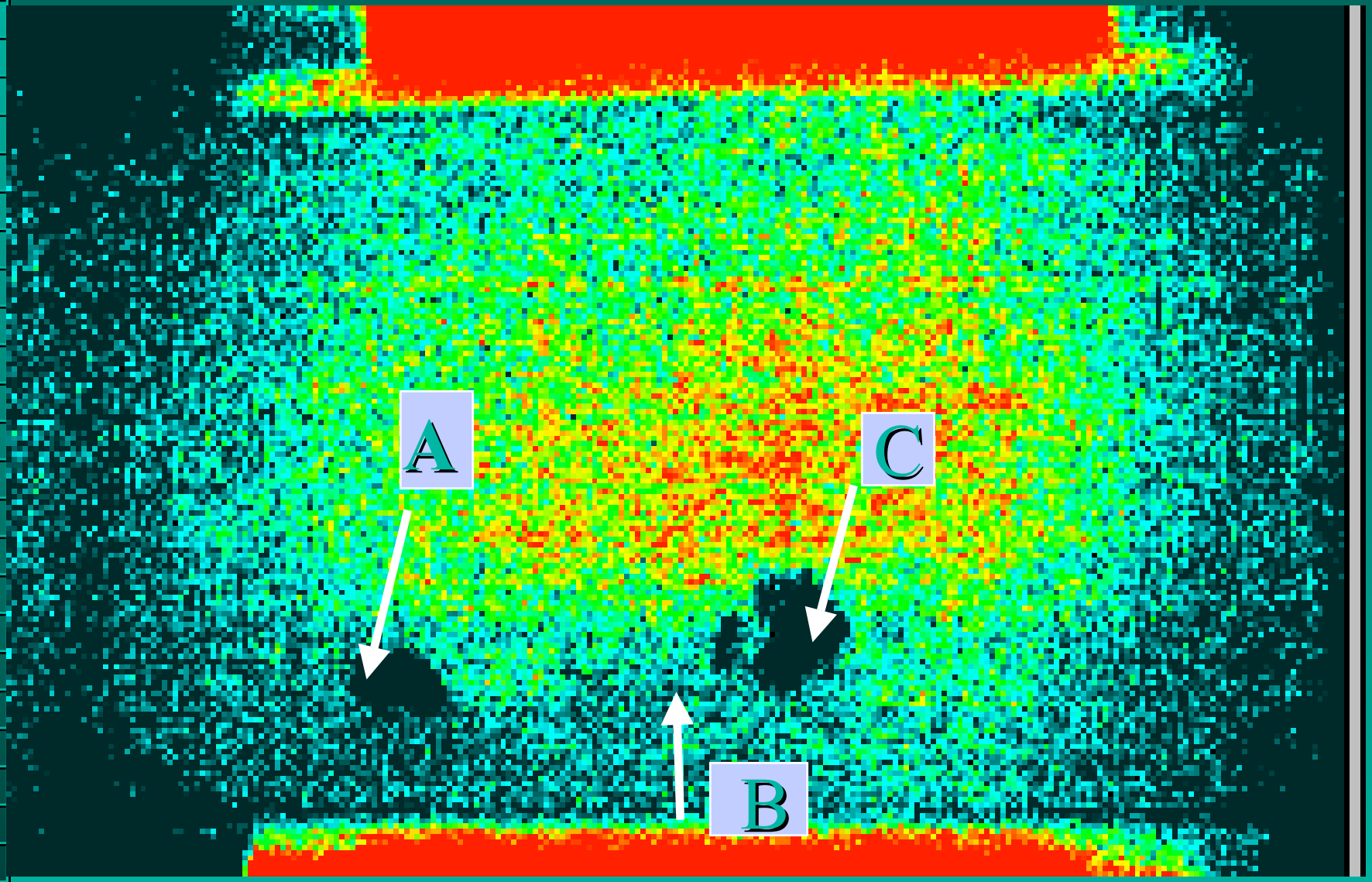
for PM and Research



16” Carbon Steel Pipe

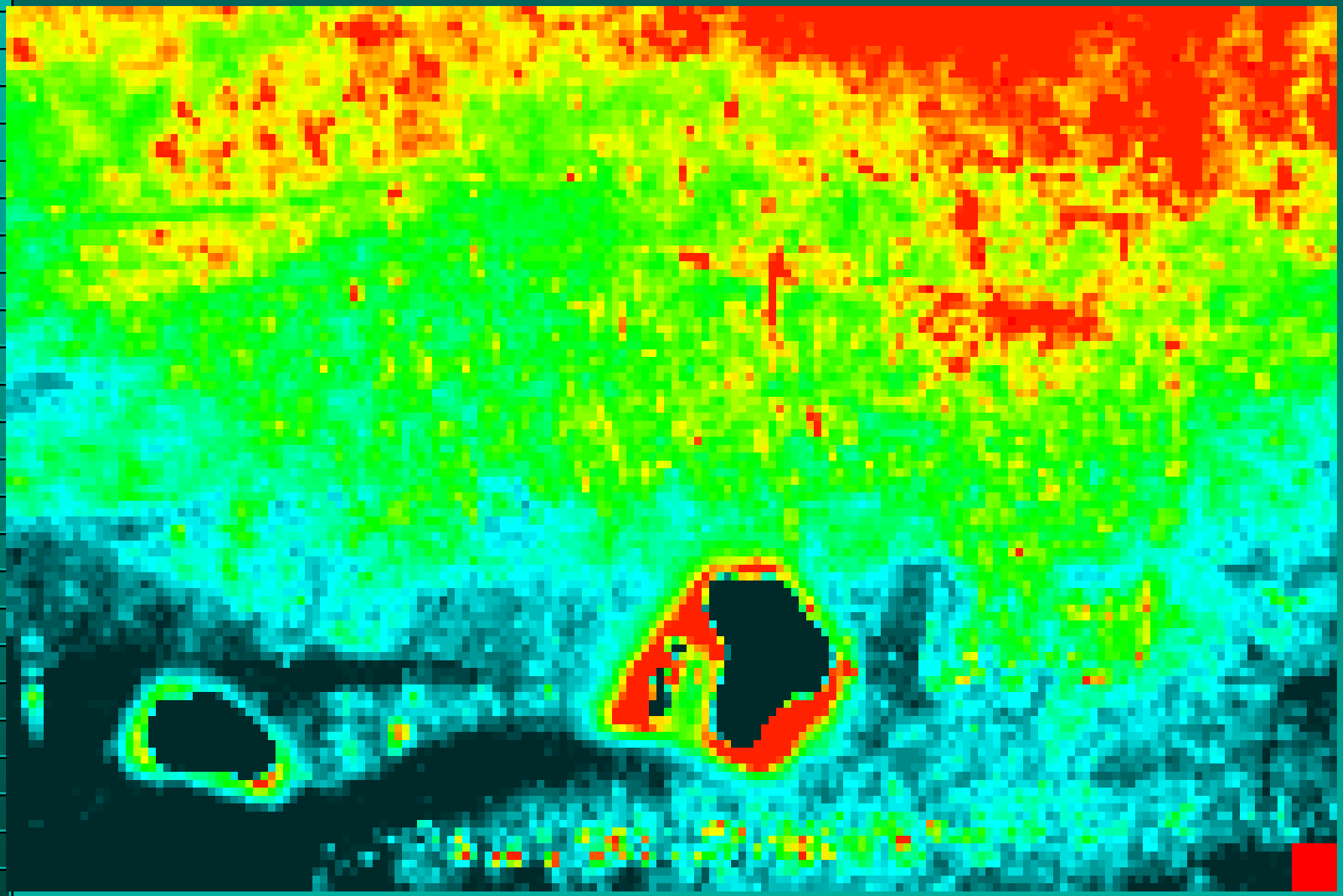
Flir

PRE-FLASH BASELINE THERMAL IMAGE



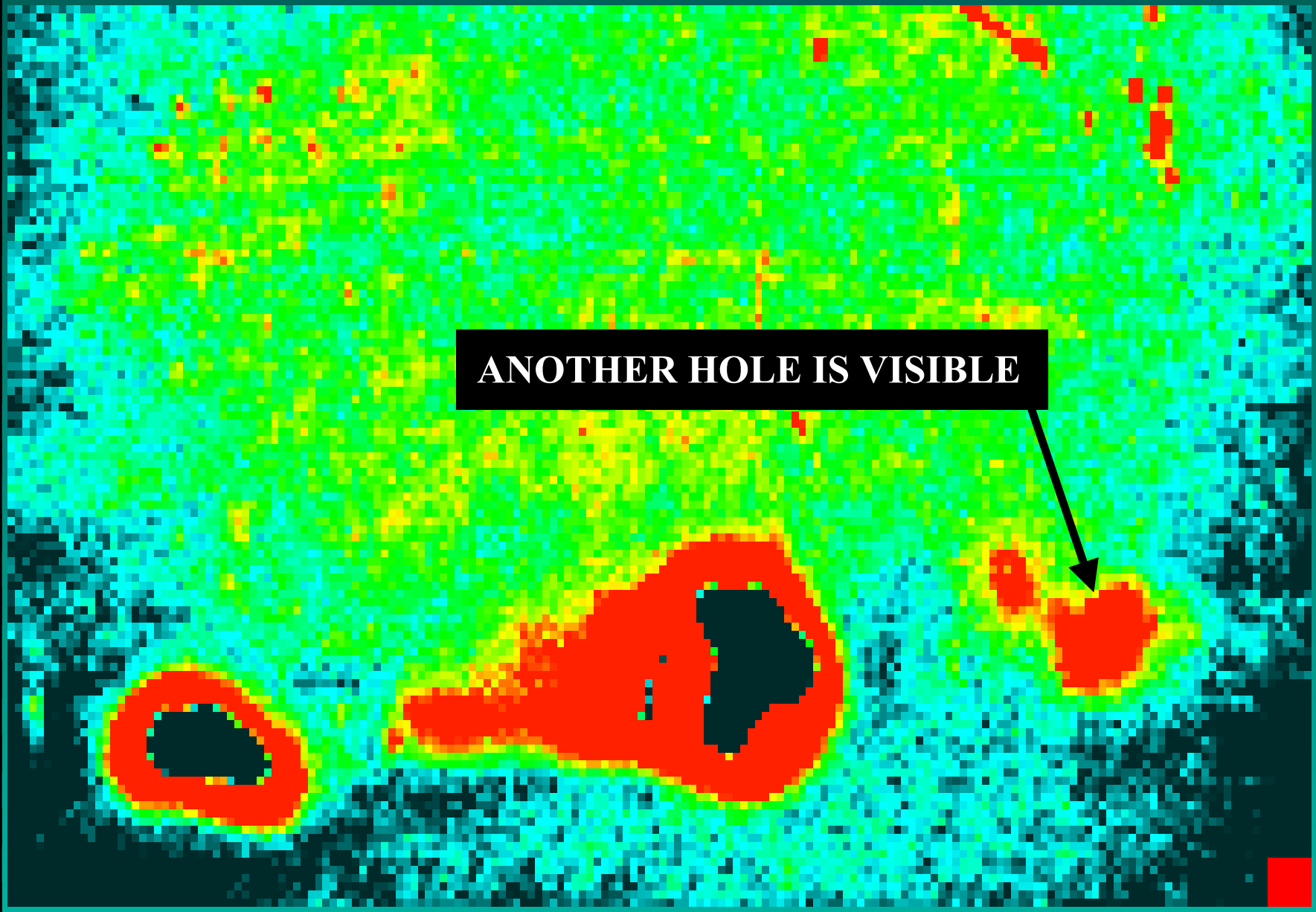
Flir

FLASH IMAGE



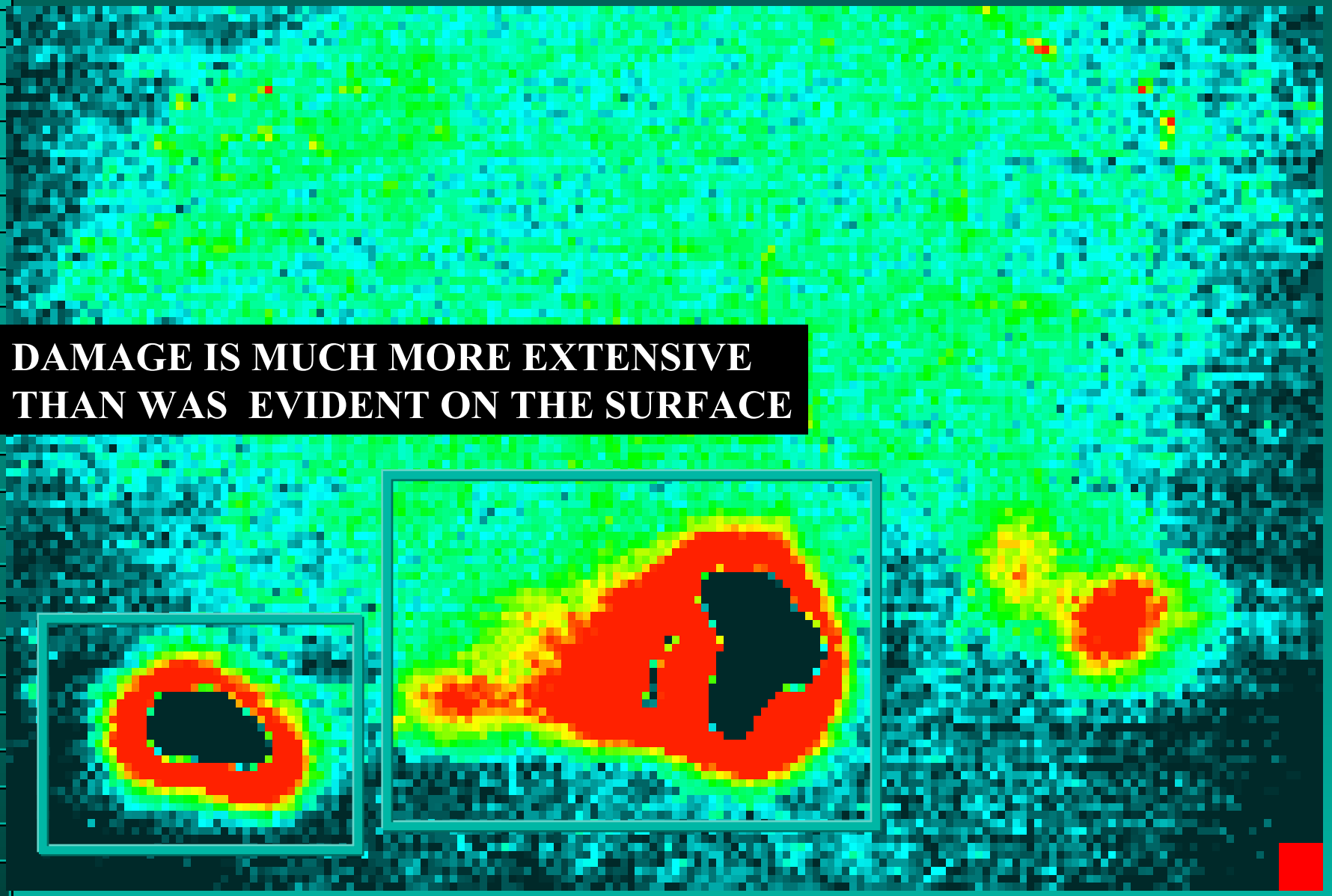
Flir

IMAGE #1



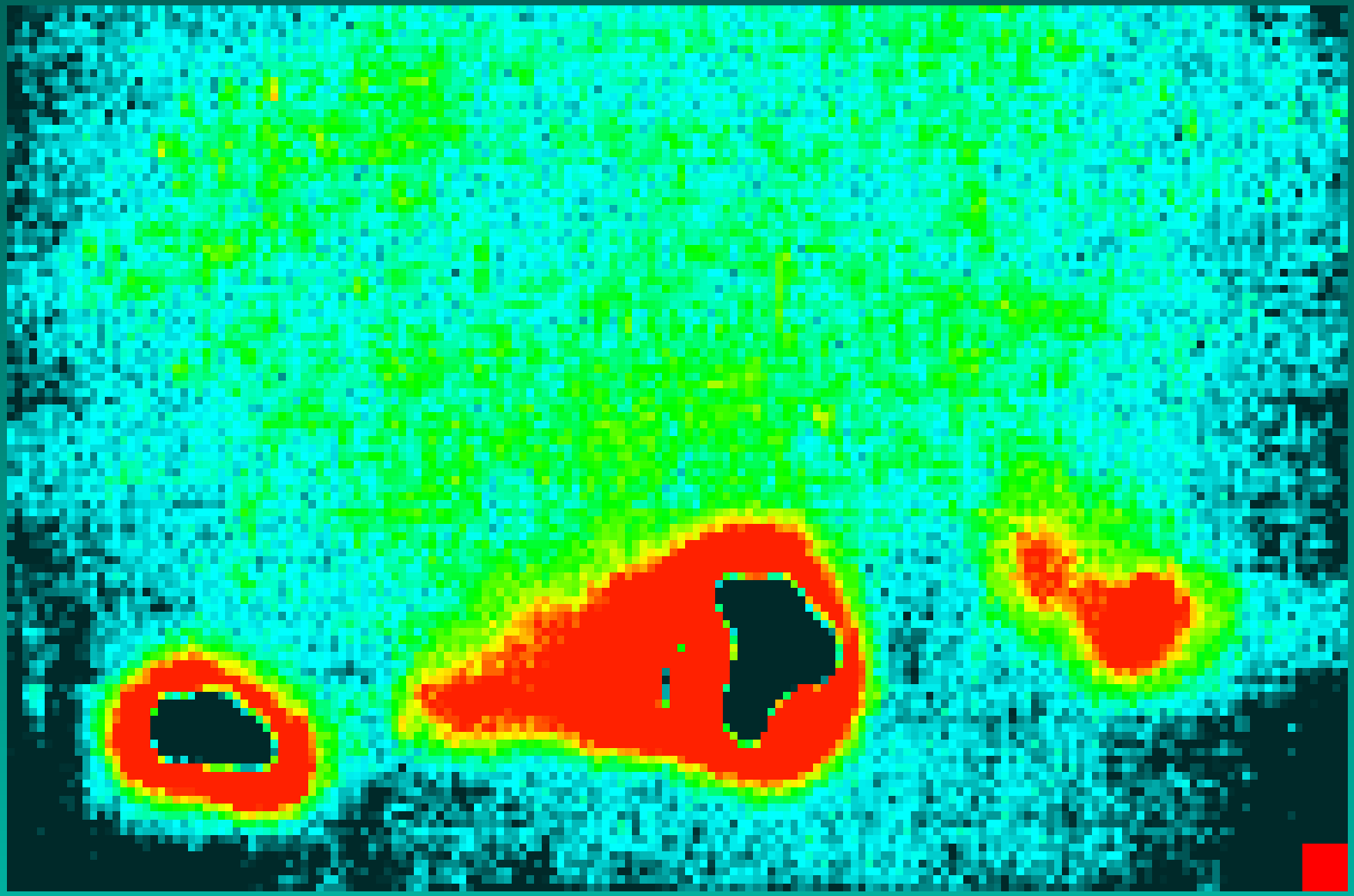
Flir

IMAGE #2


DAMAGE IS MUCH MORE EXTENSIVE
THAN WAS EVIDENT ON THE SURFACE

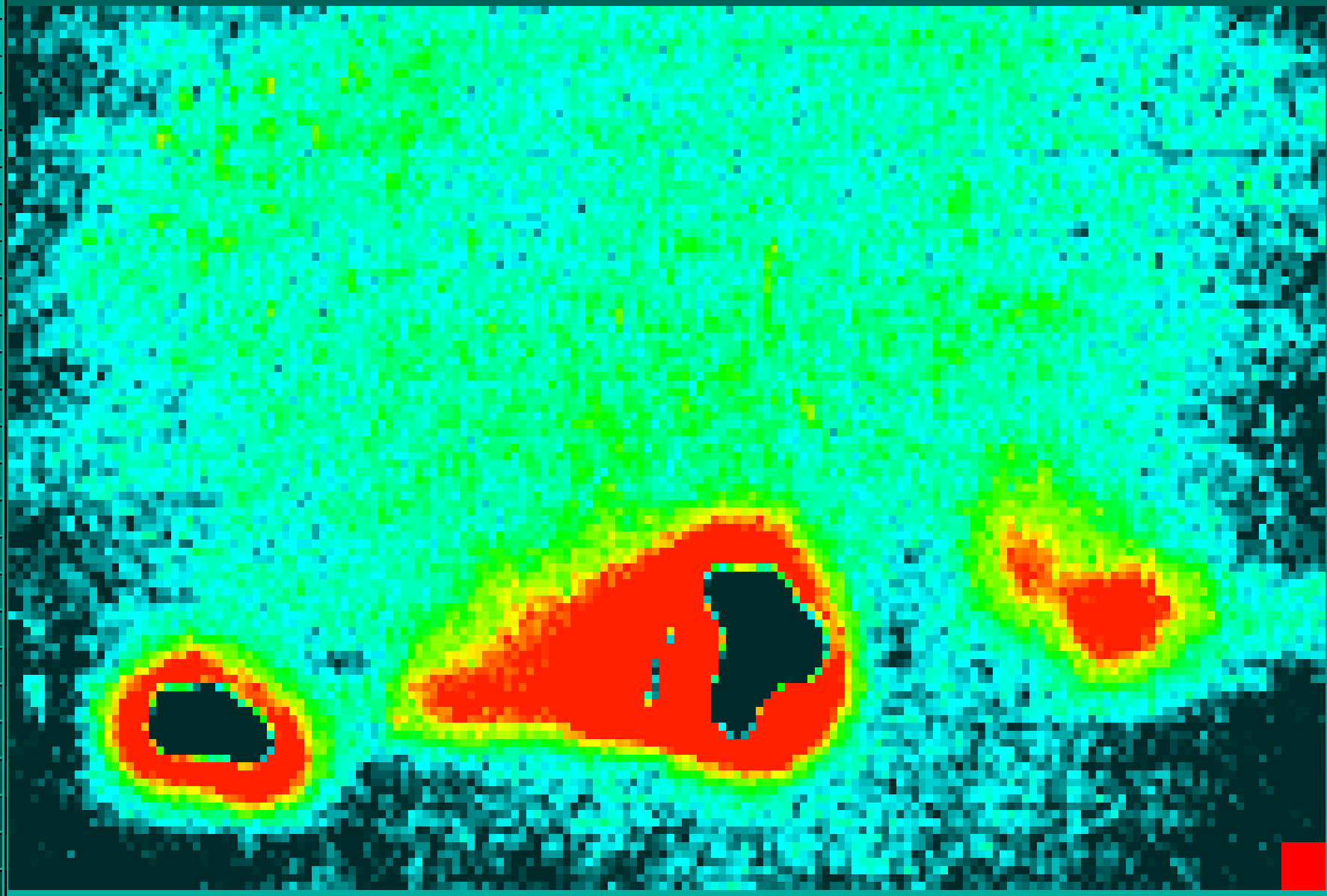
Flir

IMAGE #3



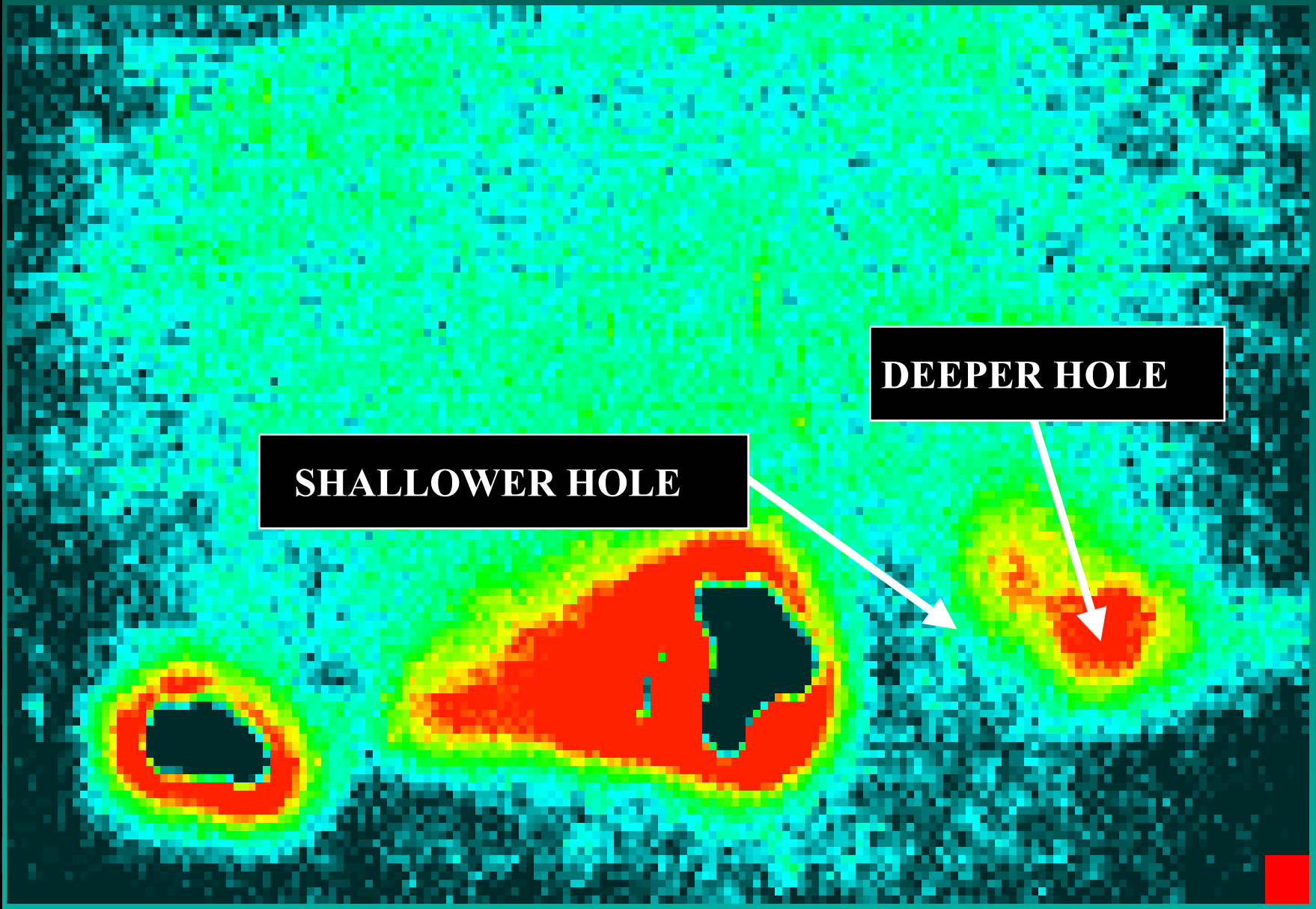
Flir

IMAGE #4



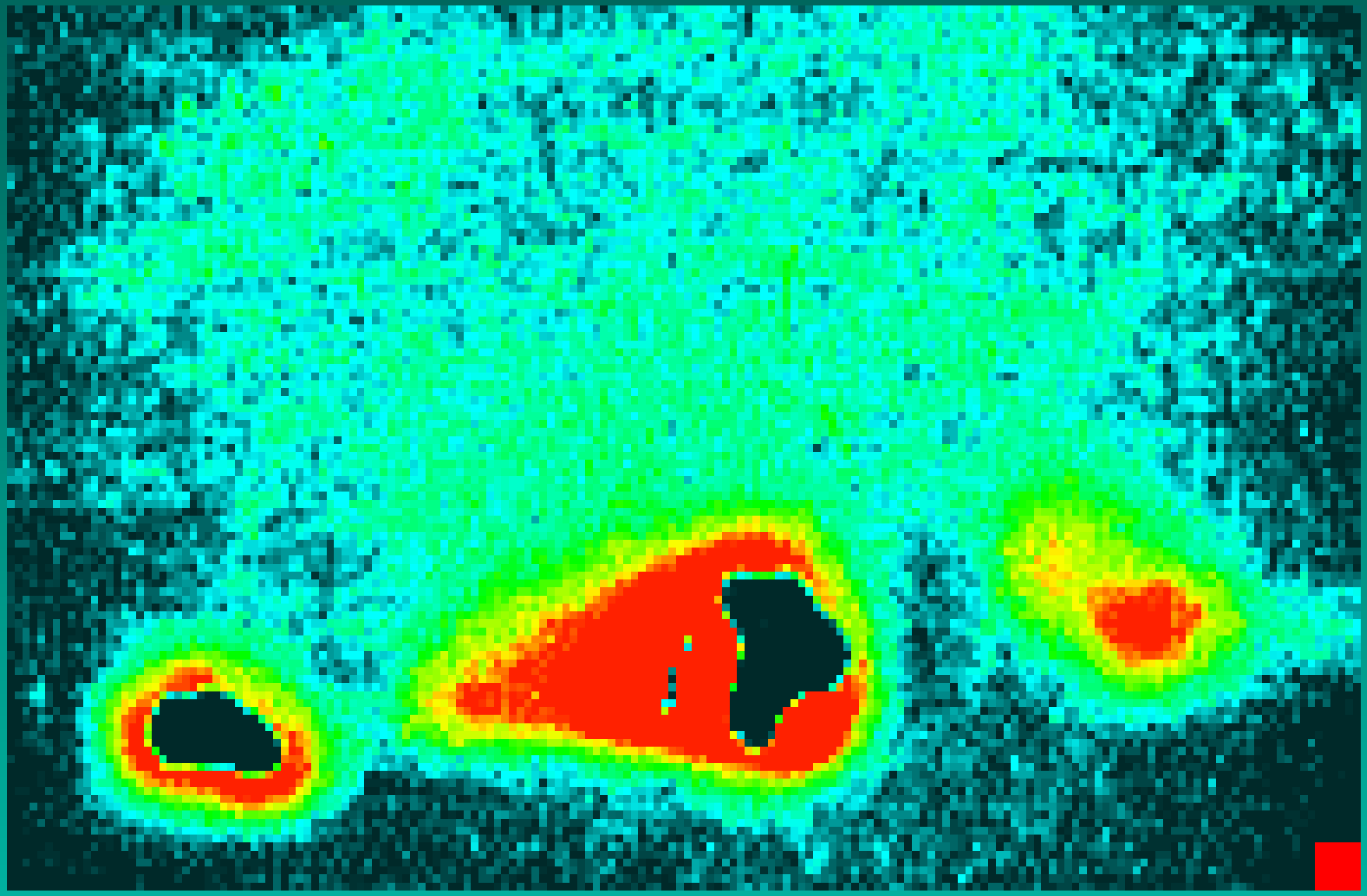
Flir

IMAGE #5



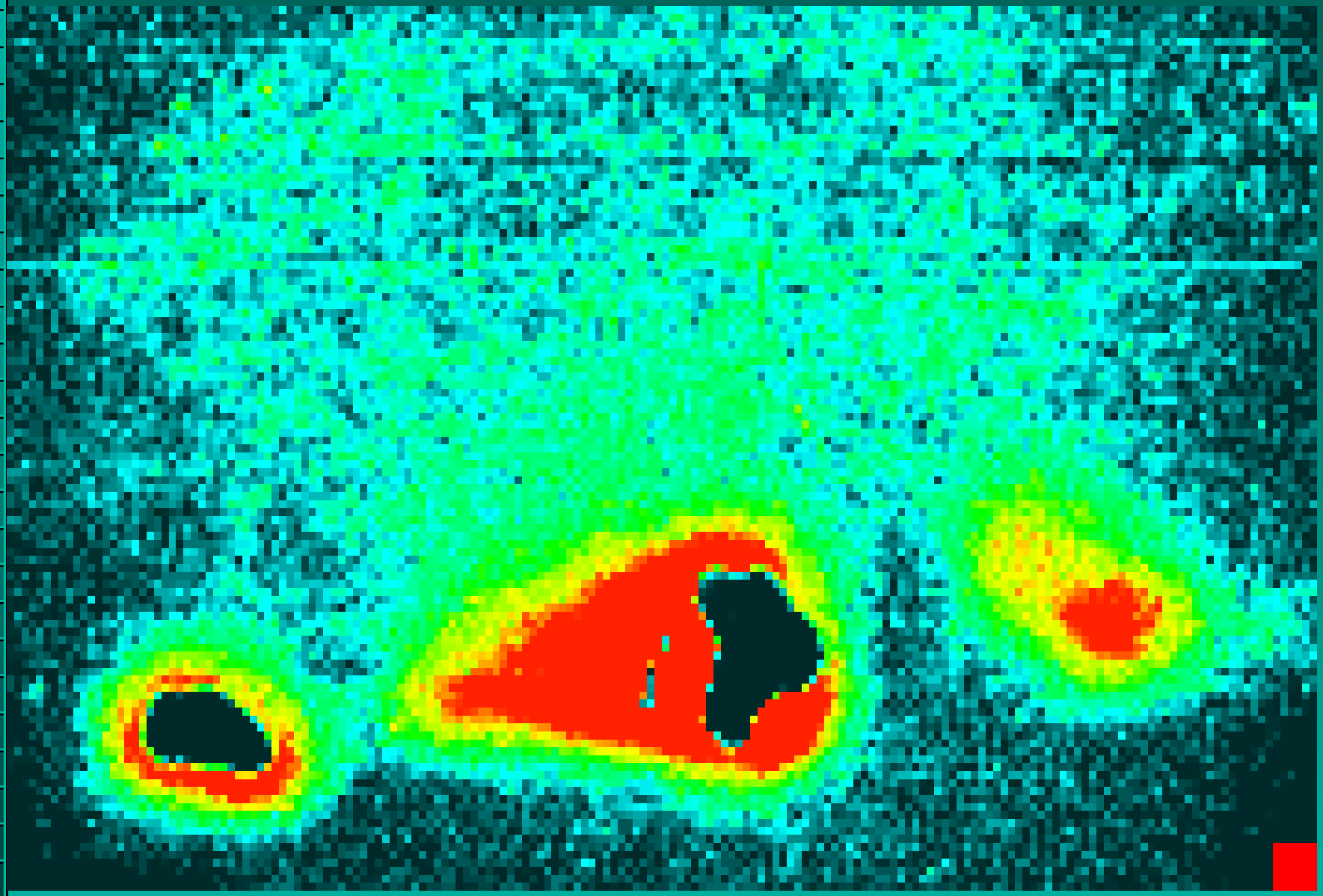
Flir

IMAGE #6



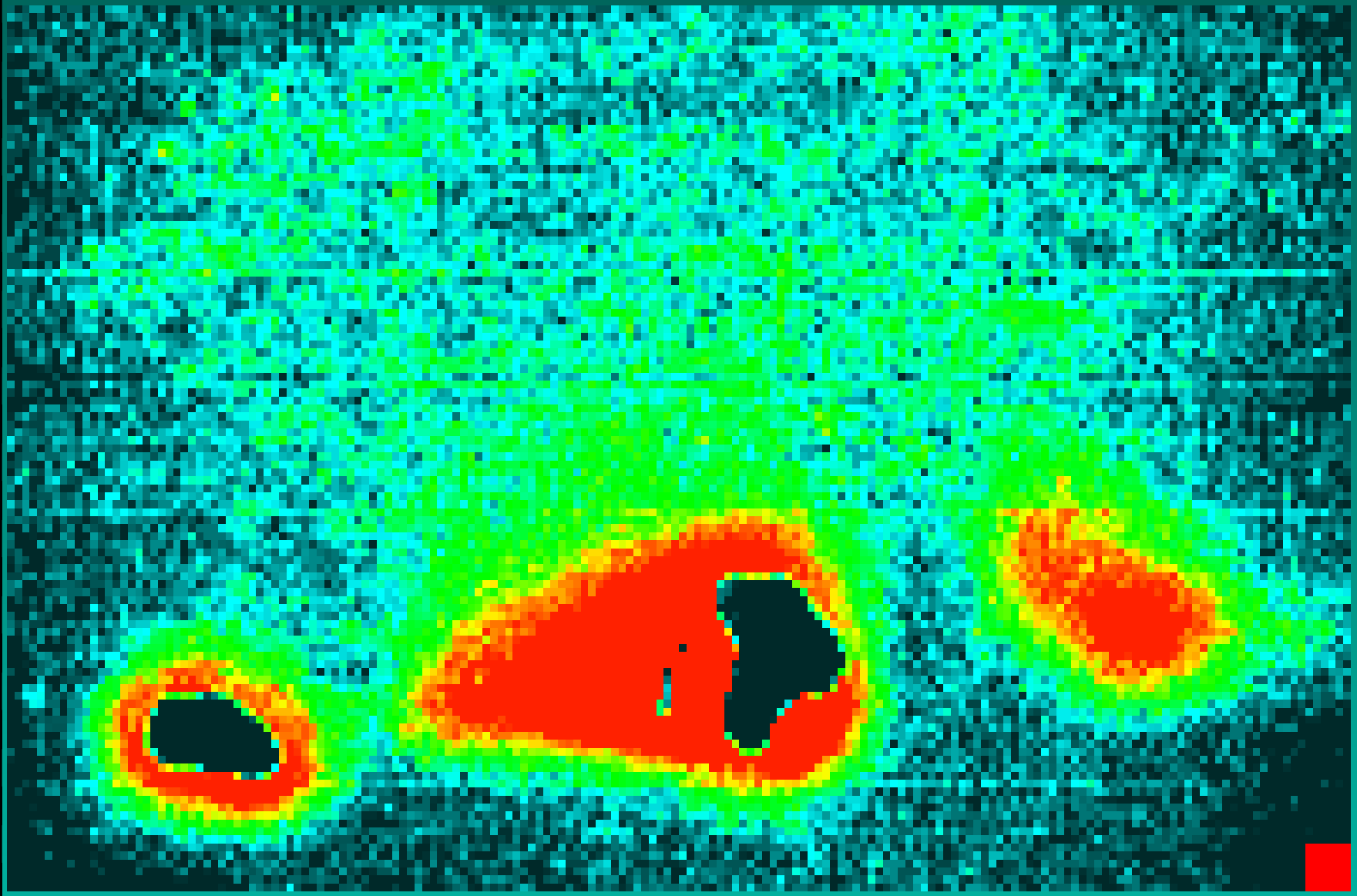
Flir

IMAGE #7



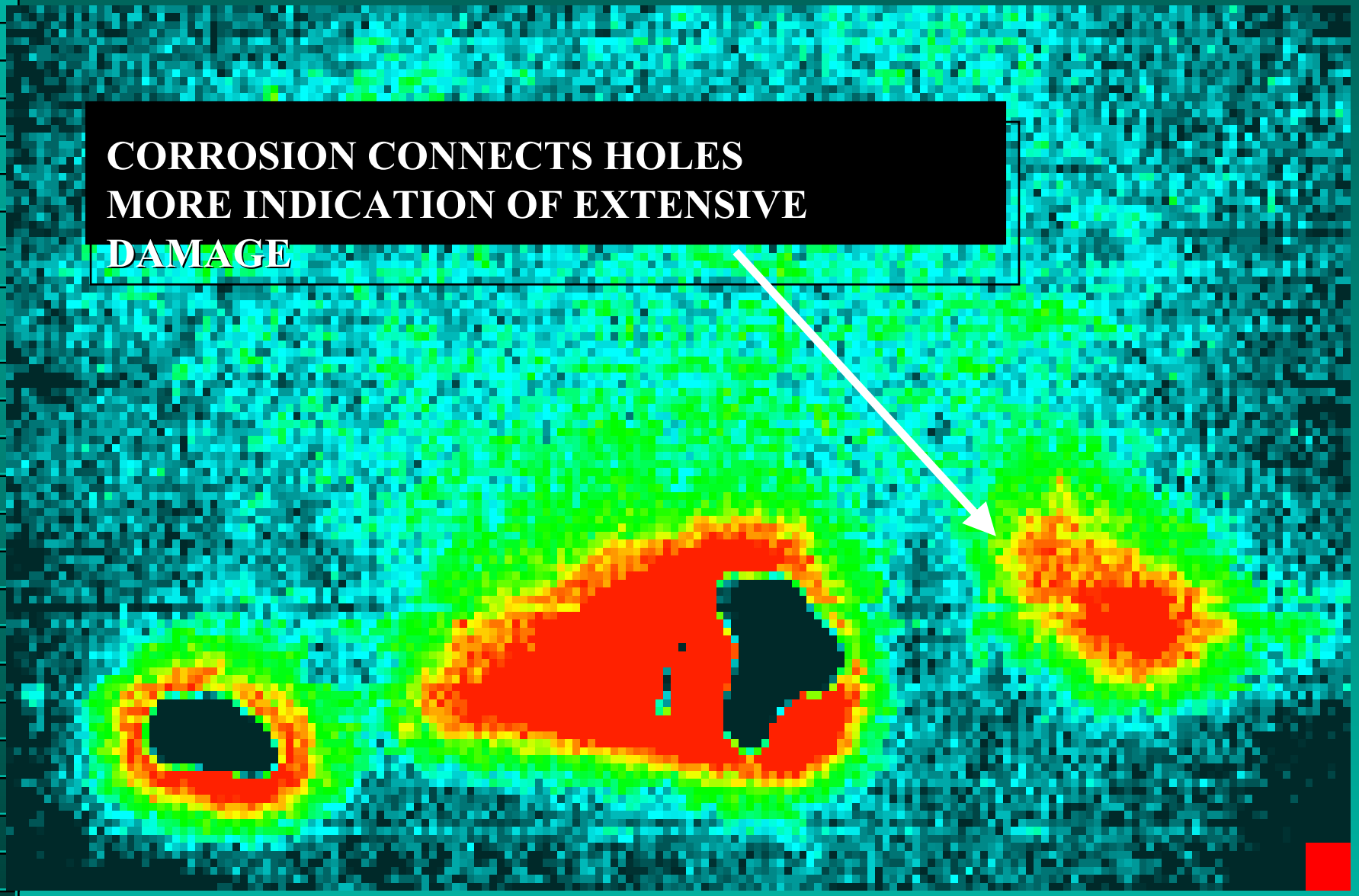
Flir

IMAGE #8



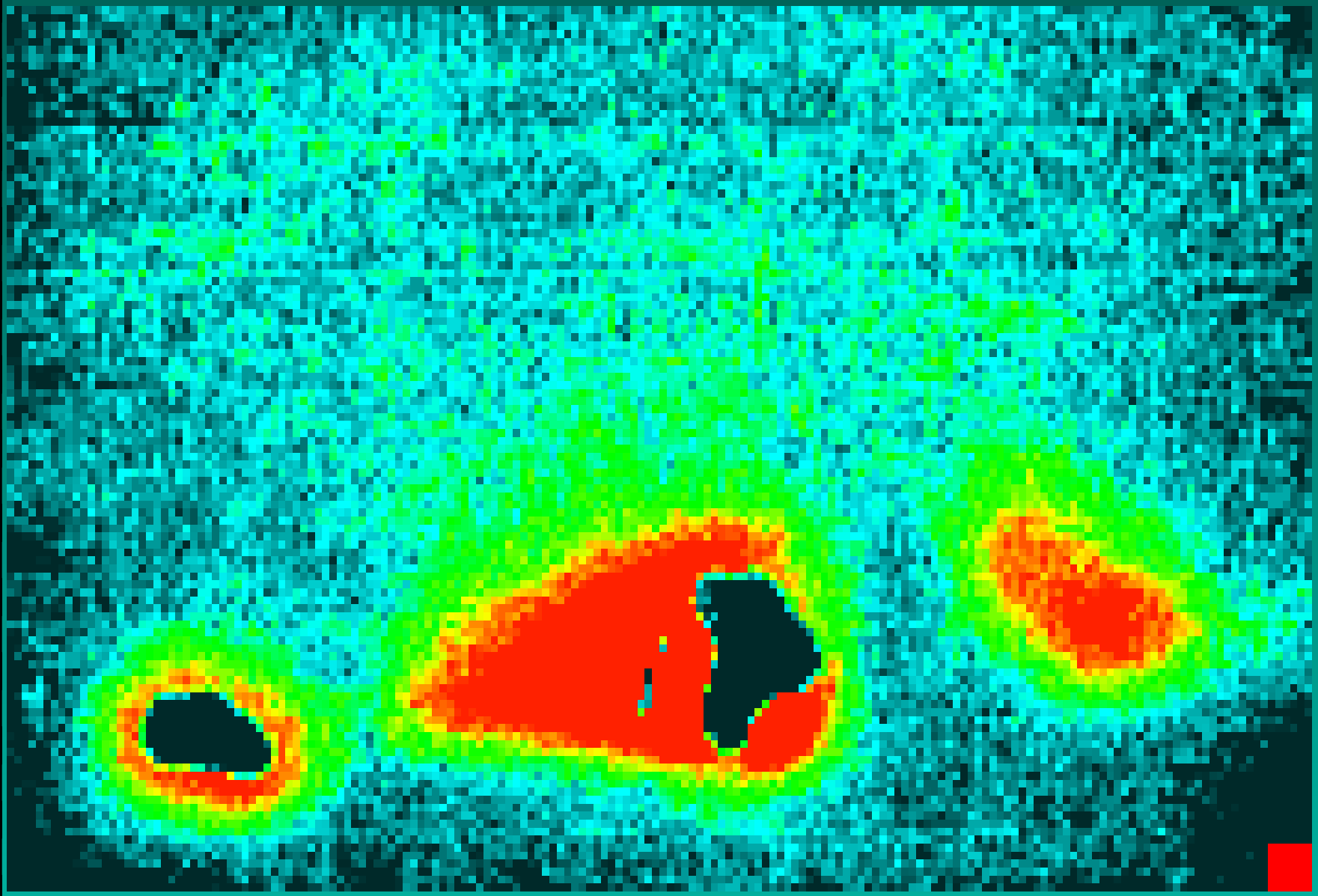
Flir

IMAGE #9


CORROSION CONNECTS HOLES
MORE INDICATION OF EXTENSIVE
DAMAGE

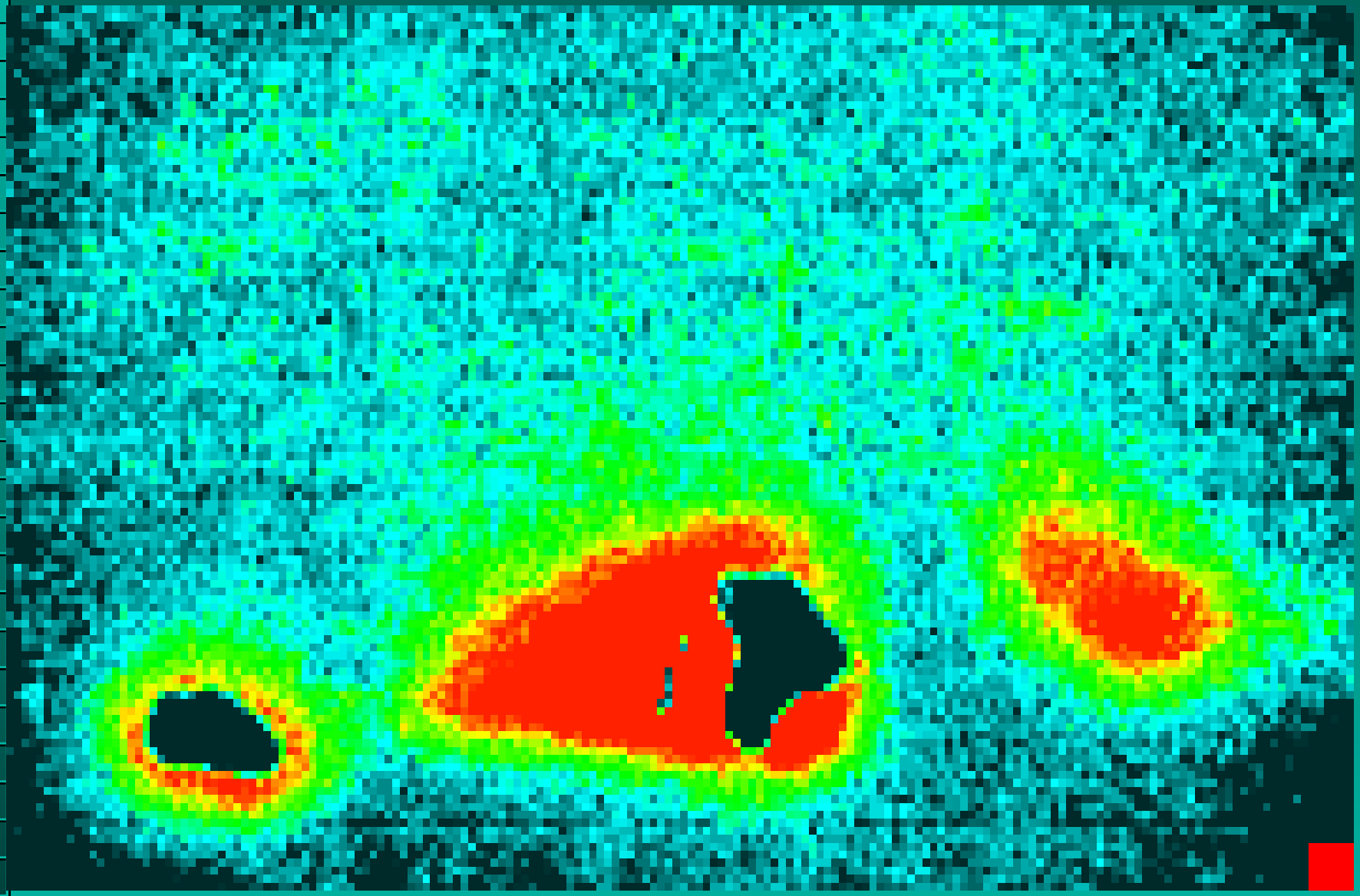
Flir

IMAGE #10



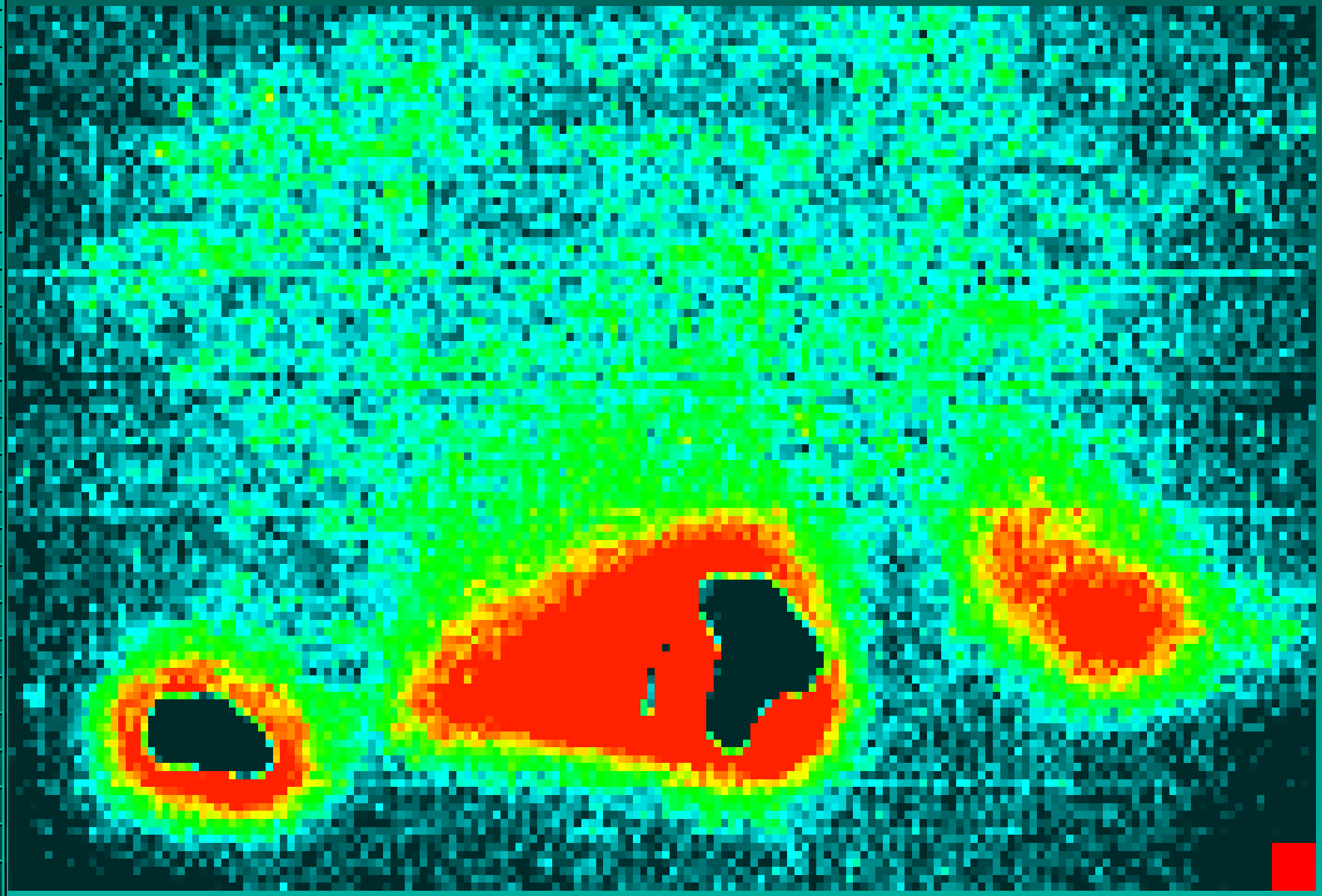
Flir

IMAGE #11



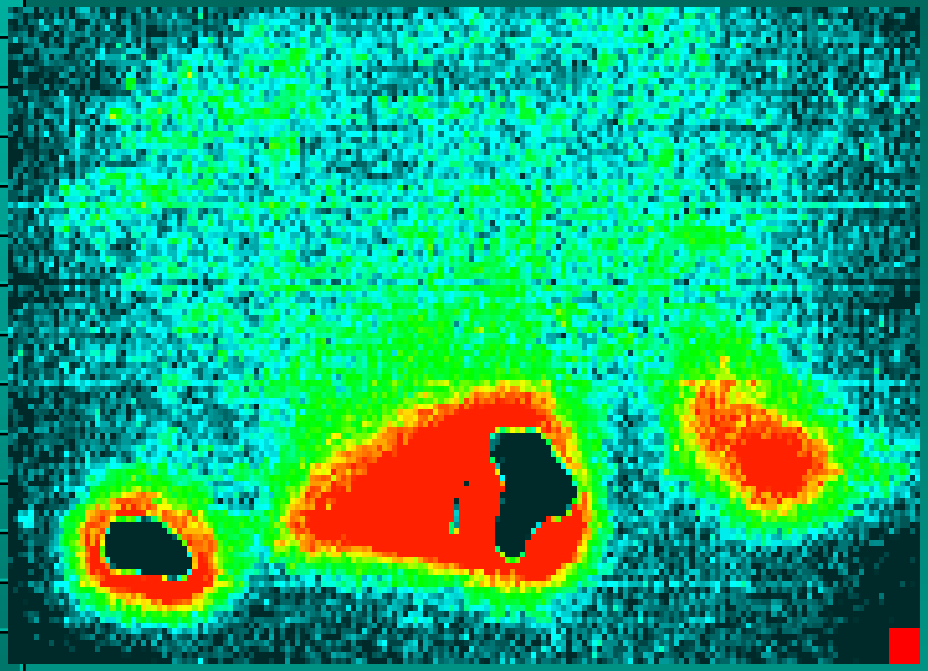
Flir

IMAGE #12



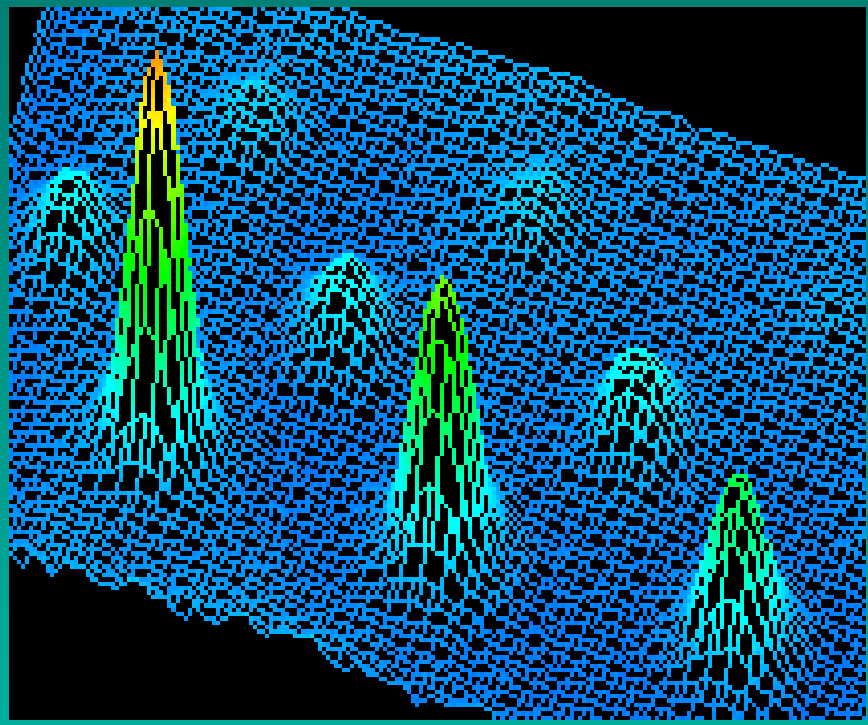
Flir

RESULTS?



3-D data at
the push of a button

Quick 2 D slices
that correlate to X/Y/Z



Flir

VERIFIED BY VISUAL EXAMINATION

OUTSIDE OF PIPE

INSIDE OF PIPE

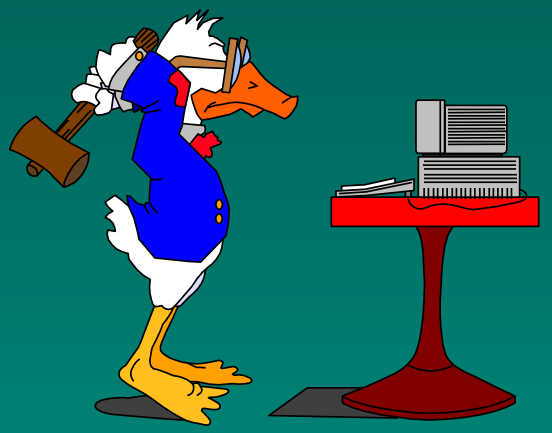
Flir

Why not use…?

- **X-Ray**
- **Ultrasound**
- **Eddy Current**

Flir

BECAUSE *ECHOTHERM* IS...



FASTER

Collects continuous digital images for
6 sec to catch sub-second events

USER FRIENDLY

Gives live image, stored image histograms and
3-D GRAPHS simultaneously
Once application parameters are set, sample runs are routine

EASILY INTERPRETED

Stored data means raw data is available even after the event is over
Can recall for second opinion or for a different test
On screen size bars make determinations fast

And at the same time…Flexible for wide variety of research applications on variety of sample types: metal, foam, composites, welds, laminates...

Flir

FLEXIBLE:

Mobile design

FAST: 6 seconds or less /cycle

Large area per scan

SUITABLE FOR ON-LINE TESTING

Preserve surface for other tests

Catch thermal reactions while part is hot

One side access of sample

DATA IS EASY TO STORE AND UNDERSTAND

Once gates are optimized, anyone with basic Windows skill can run device. Do not need high level of certification to see.

SAFE

No X-Rays, pressure or electrical excitation of sample

WHAT WORKS?

GOOD PROSPECTS

ENERGY
- Pipe wall thinning
- Storage tank corrosion
- Boiler tube scale
- Electric conduit pipe
- MIC-microbiologically. induced corrosion
- Hydrogen induced cracking

MANUFACTURING
- Automotive parts
  - Paint defects
  - Heat stress on engines

AEROSPACE
- Adhesion, bondings
- Skinned stringer disbonds
- Composites

NOT SO GOOD PROSPECTS

- Voids in foam
- Wet insulation
- Paint layers are complex
- Bare shiny metal
- Concrete- unless thin w/ near surface defects

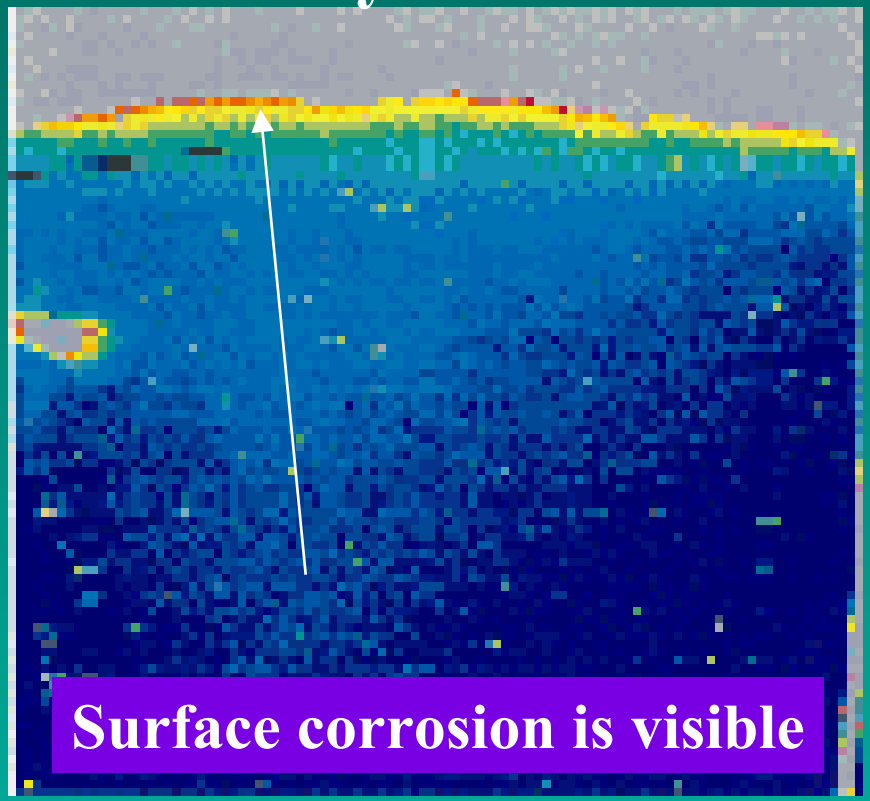
1:1 RULE:

The defect should not be deeper than its minimum width

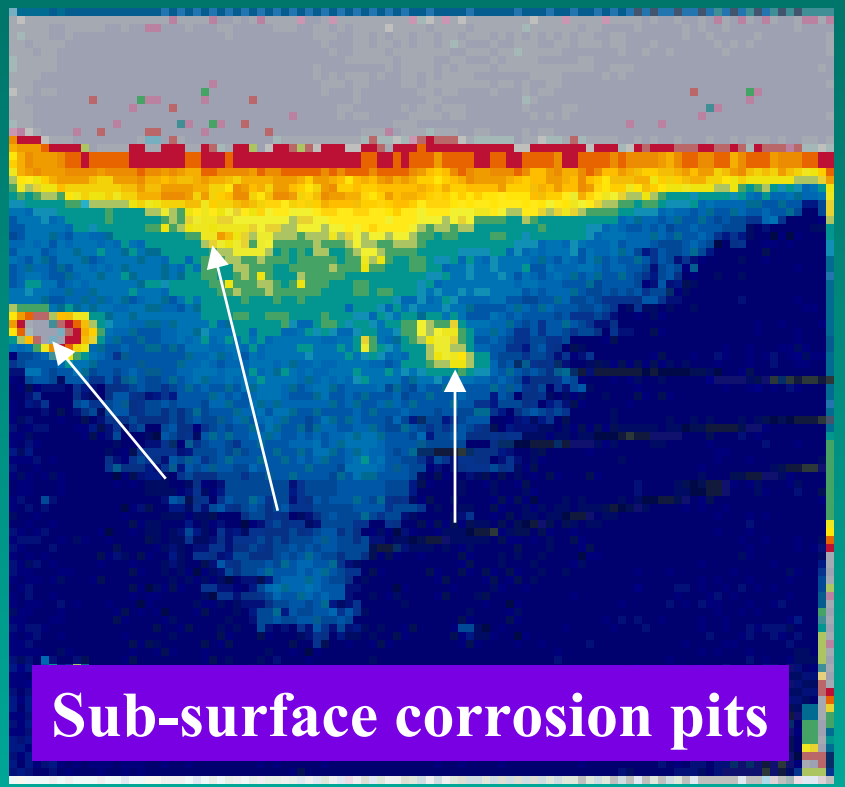
Flir

Steel Storage Tank Floor Cut-out

Shortly after flash

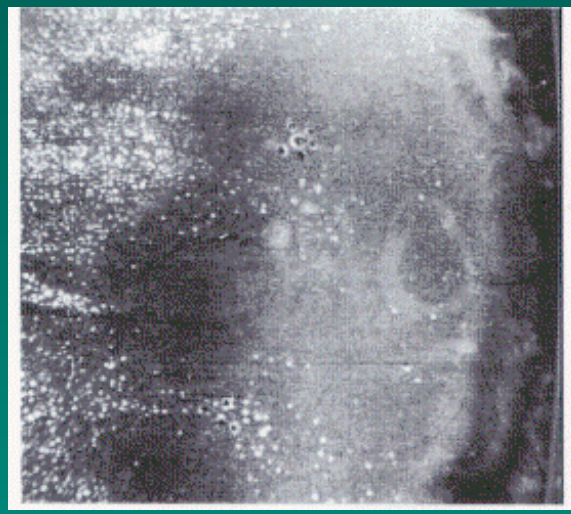


A few seconds later

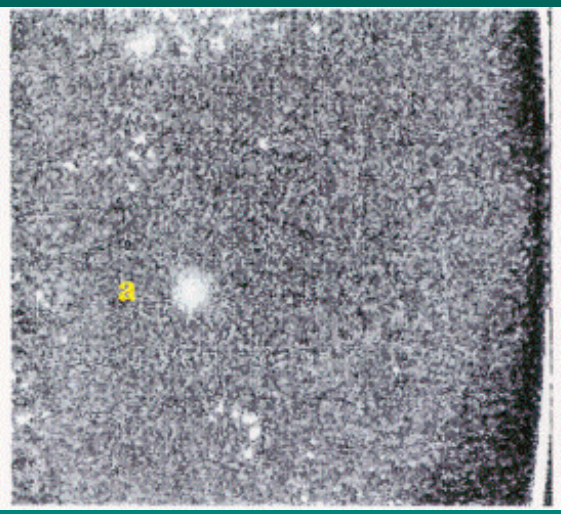


Flir

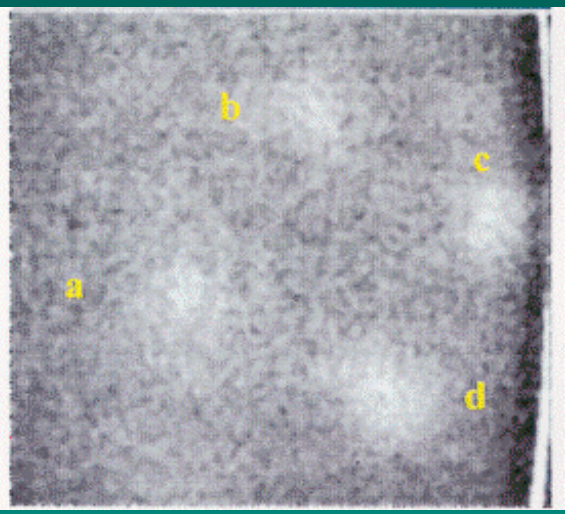
Steel Storage Tank with Corrosion



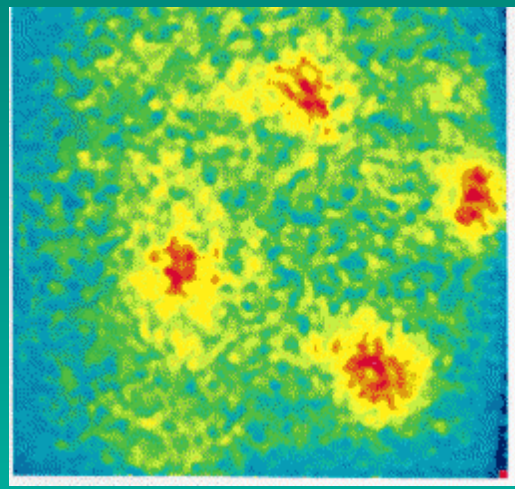
66 msec - preflash



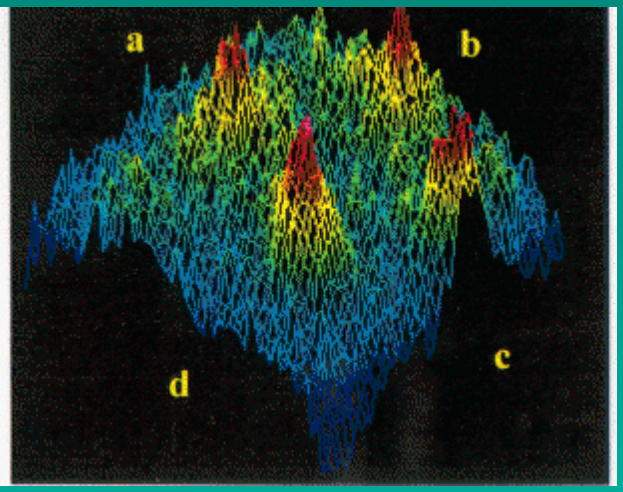
550 msec-preflash



2.68 sec-preflash



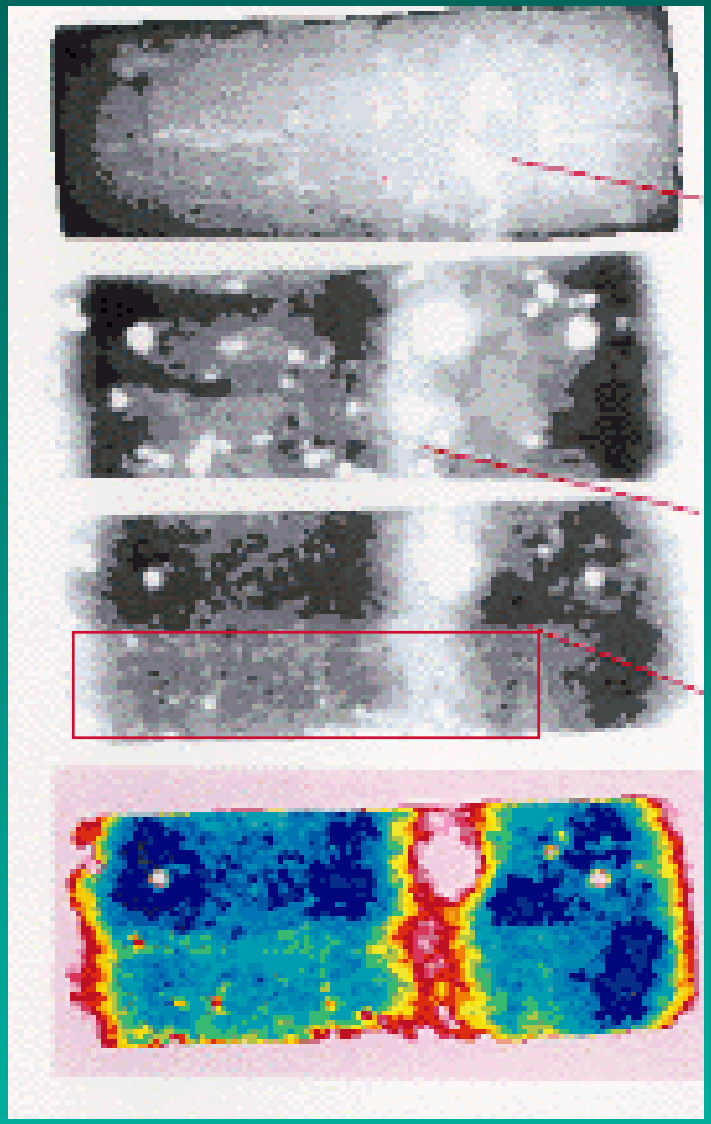
2.68 sec-preflash



3-d graph of corrosion pits

Flir

1.5” diameter Boiler Tubes



IR image prior to flash

Thinning of vertical notch

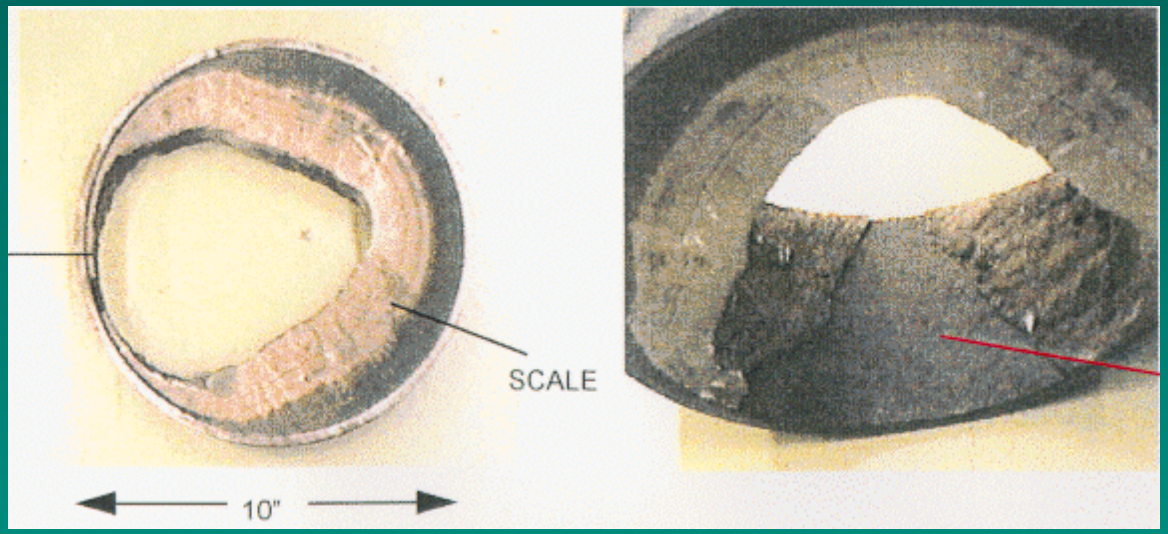
Thickness change between lower and upper halves of pipe

Psuedocolor display of above image clearly shows two types of defects

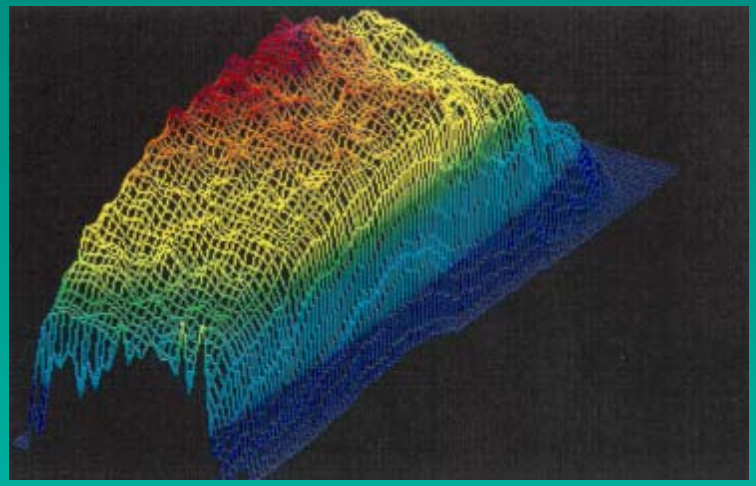
Flir

CaCo3 0.25” Thick Steel Pipe Cut-out

No Scale



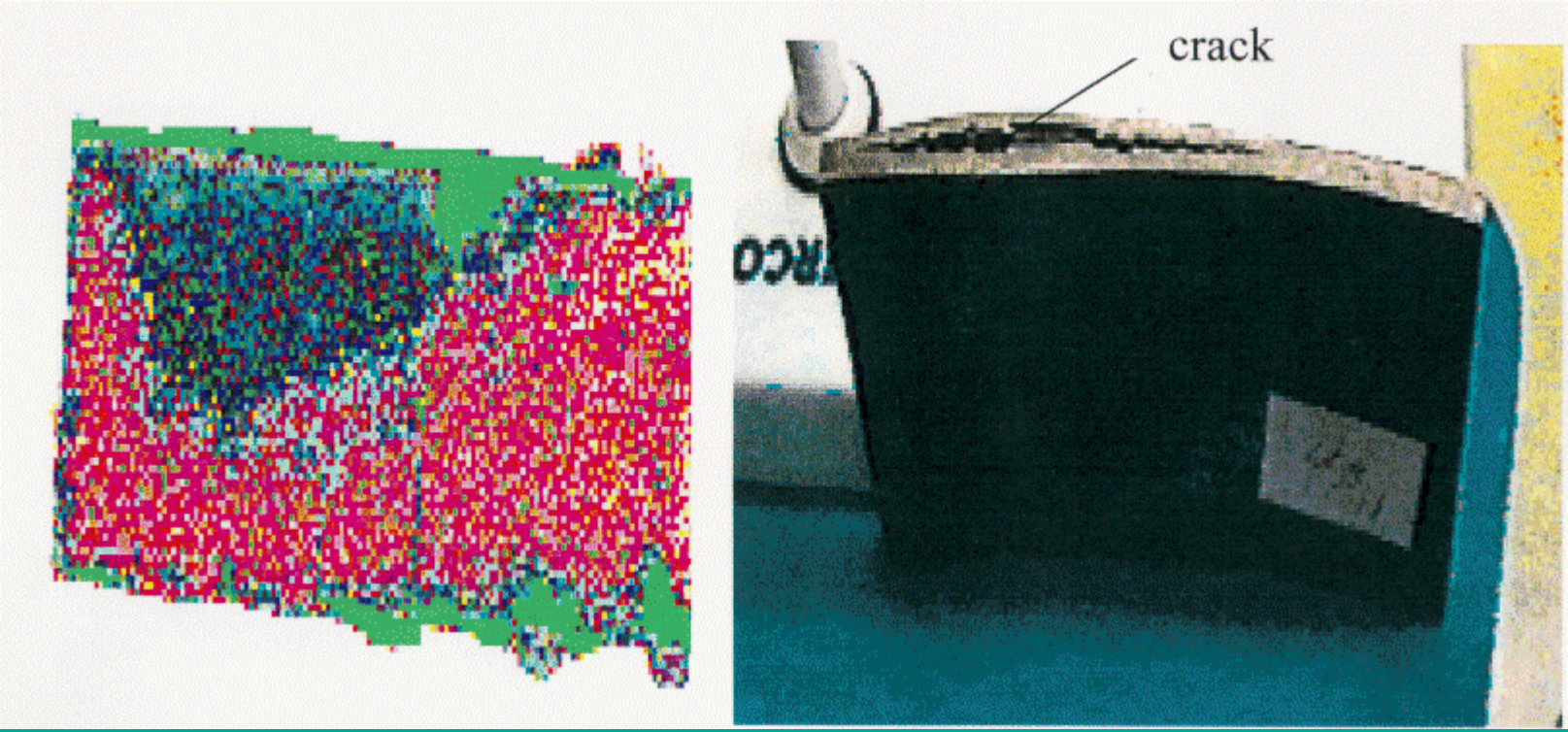
Scale chipped away



3-D colour image of
area where scale is chipped away

Flir

Hydrogen Induced Cracking in Steel



Echotherm image

Visual image

Flir